## Remarks

In the final Office Action, claims 1-2, 6-8, 10-11, 15-17, 19-20 & 25-27 were rejected under 35 U.S.C. §103(a) as being unpatentable over Huang (U.S. Patent No. 5,841,775; hereinafter Huang) in view of Newton's Telecom Dictionary (hereinafter Newton), claims 3-5, 12-14 & 22-24 were rejected under 35 U.S.C. §103(a) as being unpatentable over Huang in view of Kahale et al. (U.S. Patent No. 6,314,084; hereinafter Kahale), and claims 9, 18 & 28 were rejected under 35 U.S.C. §103(a) as being unpatentable over Huang in view of Cwilich et al. (U.S. Patent No. 6,498,778; hereinafter Cwilich). These rejections are respectfully, but most strenuously, traversed and reconsideration thereof is requested.

More particularly, Applicants request reconsideration and withdrawal of the obviousness rejections on the following grounds: (1) the combinations of documents stated in the final Office Action fail to state a *prima facie* case of obviousness against Applicants' claimed invention; (2) the documents themselves lack any teaching, suggestion or incentive for their further modification as necessary to achieve Applicants' recited invention; and (3) the purported rationale for combining Huang and Newton is deficient.

Before discussing the invention and the applied art, Applicants reiterate below certain information contained in the "Background of the Invention" section of this application, in order that the problem addressed by the present invention be well understood:

> *[0008] One consideration in the operation of any switching network is that routes used to move messages should be selected such that a desired bandwidth is available for communication. One cause of loss of bandwidth is unbalanced distribution of routes between source-destination pairs and contention therebetween. While it is not possible to avoid contention for all traffic patterns, reduction of contention should be a goal. This goal can be partially achieved through generation of a globally balanced set of routes. The complexity of route generation depends on the type and size of the network as well as the number of routes used between any source-destination pair. Various techniques have been used for generating routes in a multi- path network. While some techniques generate routes dynamically, others generate static routes based on the connectivity of the network. Dynamic methods are often self-adjusting to variations in traffic patterns and tend to achieve as even a flow of traffic as possible. Static methods, on the other hand, are pre-computed and do not change during the normal operation of the network.*

*[0009] While pre-computing routing appears to be simpler, the burden of generating an acceptable set of routes that will be optimal for a variety of traffic patterns lies heavily on the algorithm that is used. Typically, global balancing of routes is addressed by these algorithms, while the issue of local balancing is overlooked, for example, because of the complexity involved.*

*[0010] Thus, a need remains in the art for a route generation technique that generates routes that are balanced both globally and locally in switching networks which support multiple paths between source-destination pairs.*

With this background, Applicants' invention presents a static route generation technique that generates static path, source-based routes that are balanced both globally and locally for a switching network which supports multiple paths between source-destination pairs. In one aspect, Applicants recite a method (e.g., claim 1), system (e.g., claims 10 & 19), and computer program product (e.g., claim 20), for generating routes for routing data packet in a network of interconnected nodes. The nodes are at least partially interconnected by links. Applicants' route generation technique includes: generating static path, source-based routes for routing data packets in the network of interconnected nodes. The generating of static path, source-based routes includes: (i) selecting a source node – destination node (S-D) group with common starting and ending sets of links from the network of interconnected nodes; and (ii) selecting shortest static path, source-based routes between at least some S-D nodes of the S-D group so that: (a) selected static path, source-based routes substantially uniformly fan out from the source nodes to a center of the network and fan in from the center of the network to the destination nodes; (b) *local balance of static path, source-based routes between selected S-D nodes of the S-D group passing through links that are at the same level of the network is achieved*; and (c) global balance of static path, source-based routes passing through links that are at a same level of the network is achieved. No similar functionality is believed taught or suggested by the known art, including the applied art.

No *Prima Facie* Case of Obviousness:

Initially, Applicants respectfully submit that the final Office Action fails to state a *prima facie* case of obviousness against their pending claims.

First, with respect to the obviousness rejection of claims 1-2, 6-8, 10-11, 15-17, 19-20 & 25-27, the final Office Action asserts that Huang in combination with Newton render obvious the claims at issue. However, the Office Action does not address certain aspects of the amended claims presented on July 21, 2005. Specifically, each of Applicants' independent claims now recite that the "generating static path, source-based routes for routing data packets in the network of interconnected nodes includes: (ii) selecting shortest static path, source-based routes between at least some S-D nodes of the S-D group so that: ... (b) local balance of static path, source-based routes between selected S-D nodes of the S-D group passing through links that are at a same level of the network is achieved; and ..." A careful reading of the final Office Action (and the applied art) fails to uncover any discussion of this aspect of Applicants' claimed generation technique. As such, a *prima facie* case of obviousness is not stated in the rejection. For at least this reason, reconsideration and withdrawal of the final Office Action is respectfully requested.

Similarly, Applicants respectfully submit that the remaining obviousness rejections to the dependent claims fail to state a *prima facie* case of obviousness against the claims at issue. Further, the final Office Action recognizes at page 2, lines 17 & 18 that the route generation approach of Huang fails to implement a static path and source-based routing technique. (As such, the final Office Action cites Newton with respect to the above-noted claims.) However, in the secondary rejection to claims 3-5, 12-14 & 22-24, as well as the secondary rejection to claims 9, 18 & 28, the final Office Action does not address this aspect of the claims at issue. Since the Office Action recognizes that Huang fails to disclose Applicants' recited generating static path, source-based routes for routing data packets in the network of interconnected nodes, and since both Kahale and Cwilich do not describe generating static path, source-based routes for routing data packets in a network of interconnected nodes, no *prima facie* obviousness rejection of these claims is stated. This is in addition to the above-noted deficiency of the base rejection of Huang in view of Newton applied against the independent claims.

For at least the above reasons, Applicants respectfully request withdrawal of the finality of the outstanding Office Action, and reconsideration and allowance of all claims at issue.

Huang & Newton Lack Any Teaching, Suggestion or Incentive for Their Further Modification as Necessary to Achieve Applicants' Recited Invention:

Huang describes a scalable switching network wherein routers provide destination routing. A switching fabric of routers is used to implement a scalable switching network. The switching fabric supplies the connectivity. The routers supply the routing, maintenance, and administrative functions. The switching fabric and routers cooperate to reduce hardware, delay, and jitter; and provide fault tolerance, internal load balancing, input load balancing, output load balancing, and shared distributed output buffering. (See column 5, lines 26-34 of Huang.)

Each of the independent claims presented herewith recites generating static path, source-based routes for routing data packets in the network of interconnected nodes including, in part, selecting shortest, static path, source-based routes between at least some S-D nodes of the S-D group so that, at least, *local balance of the static path, source-based routes between selected S-D nodes of the S-D group passing through links that are at a same level of the network is achieved.* Applicants respectfully submit that at least this characterization distinguishes Applicants' static path, source-based generation of routes from any prior algorithm known in the art.

Local balance, as defined in paragraph [0044] of the application, refers to the spread of the source-destination pairs whose routes pass through an individual link in the network. Local balance, in this context, means there is a substantially uniform selection of source-destination pairs whose routes pass through a link from a complete set of source-destination pairs whose routes can pass through a link. In the example network, each switchboard is connected to 16 hosts, a host being both a source and a destination depending on the direction of the message. Each board, in turn, has four switch chips, each of which is connected to four hosts (see FIG. 2 of the application). FIG. 3 shows a source-destination group A-B, while FIG. 5 shows another source-destination group A, C. In each case, there are 16 source-destination pairs which share the paths shown in FIGS. 4 & 6.

In order to be locally balanced, A1 should use one of 1/2/3/4 to reach B1, one of 5/6/7/8 to reach B2, and one of 9/10/11/12 to reach B3, and one of 13/14/15/16 to reach B4. Likewise, A2, A3 and A4 should use one of the remaining in each set of four to reach the destinations on B. The marked source-destination groups share the same set of board-board links, or second level

links, with the other source-destination groups. Also, the links from a NSB are used to build routes to all other NSBs in the network. Global balance only ensures that there are equal numbers of routes passing through these links. Hence, an algorithm which attempts to achieve global balance does not necessarily tend to achieve local balance.

In the other illustration of FIGS. 5 & 6 of the application, there are 64 paths available between source-destination group A-C. A simple route generation algorithm that achieves global balance, chooses a 16-path solution as shown in FIG. 7 of the application. When all route tables are generated, the 64 level 3 links are equally loaded, providing global balance. If all four hosts at A communicate with all four hosts at C, pair-wise at the same time, the messages will collide at the last two hops as shown in FIG. 7. The fanning route generation technique of the present application corrects this condition and selects the 16 paths shown in FIG. 8, applying the same criterion as before for source-destination group A-B. This idea of local balancing extends to board-board communication groups in a similar manner.

A careful reading of Huang, and the Newton's Telecom Dictionary definition, fails to uncover any teaching or suggestion of a static path, source-based route generation technique which selects the shortest static path, source-based routes based, in part, on a consideration for local balancing of the routes between selected S-D nodes of the S-D group passing through links that are at same level of the network. Based on this omission, Applicants respectfully submit that one of ordinary skill in the art would not have read the teachings thereof as suggesting Applicants' invention as recited in the independent claims presented. For this additional reason, reconsideration and withdrawal of the obviousness rejection to all claims is respectfully requested.

Rationale for Combining Huang & Newton is Deficient:

As explained at column 1, lines 28-39 of Huang, there are two basic approaches to providing routing needed to support switching or routing. One approach is destination-based, such as the Internet. The other approach is path-based, such as the telephone network. Destination routing is based on a table look-up at each decision point. It is flexible since it is loosely coupled with the topology of the network, however, the routing decisions are more complex since knowledge of the overall network is required at each decision point. In path-

based routing, all the routing decisions are pre-determined and represented by the telephone number or address. This is tightly coupled to the topology of the network.

In the language of paragraphs [0008] – [0010] of the present application, Huang is a destination routing technique wherein the routers dynamically generate routes based on traffic patterns within the network. In comparison, the present invention is directed to a path-based routing approach, which is referred to in Applicants' claims as a "static path, source-based routing". Thus, there is a fundamental difference between the routing approach of Huang and Applicants' recited routing technique. Huang relates to a network in which routers provide destination routing, i.e., the routers are active devices that dynamically decide the port through which an incoming packet is to be sent. In comparison, Applicants recite a type of path-based routing, that is, the generating of static path, source-based routes. In Applicants' approach, the network routers are passive devices that send incoming packets through an output port coded into the path or route sent along with the packet from the source. Thus, Applicants' routes are static path, source-based routes. In view of this fundamental difference, Applicants respectfully submit that Huang's technique is unusable for static routing as recited by Applicants.

More particularly, Huang describes what is termed "enhanced connectivity". Huang refers to three types of load balancing, i.e., internal, input and output. These are combined with shared distributed output buffering to use the network. The routers in this case are active. A description of how the routers work can be found at column 6, lines 12-32 of Huang. Essentially, each router builds a routing table and broadcasts it to its neighbors. Based on the received broadcast, the routes build a map of the network which is used to determine the next best hop for each destination. This is summarized at column 7, lines 14-26 of Huang, which states that the routing needed to take advantage of this enhanced connectivity is provided by TCP/IP's destination based routing and dynamic routing. In contrast, Applicants' claimed invention is a source-based, static routing approach. There is no evidence that Huang's method could be extended to static, source-based routing. In fact, Huang teaches otherwise, at column 10, lines 39-42, which state **that it would be difficult for path-based routing to take advantage of the enhanced connectivity described therein**. The routers used for static and dynamic routing vary in architecture and one skilled in the art would not readily extract teachings in one environment and apply them to another environment as proposed in the final

Office Action. For this additional reason, reconsideration and withdrawal of the obviousness rejection to the independent claims is respectfully requested.

To summarize, Applicants' independent claims recite that the generating of the static path, source-based routes includes selecting the shortest static path, source-based routes between at least some source-destination nodes of the source-destination group so that *local balance of the static path, source-based routes between selected S-D nodes of the group passing through links that are at the same level of the network is achieved*, and global balance of the static path, source-based routes passing through links that are at the same level of the network is achieved. As defined at paragraphs [0043] & [0044] of the present application, a system is "globally balanced" if there are a same or a substantially same number of routes passing through links that are at a same level of the network. That is, a globally balanced network is a network wherein links at the same level of the network carry a same static load. "Local balancing" refers to the spread of the source-destination pairs whose routes pass through an individual link of the network. Local balance means that there is a substantially uniform selection of source-destination pairs whose routes pass through a link from a complete set of source-destination pairs whose routes can pass through a link.

Applicants respectfully submit that a careful reading of Huang and Newton fail to uncover any facility for generating static path, source-based routes for routing data packet in a network which includes selecting shortest static path, source-based routes so that both local balance and global balancing of the routes is achieved as the terms are defined in the present application and employed in the independent claims at issue.

The dependent claims are believed allowable for the same reasons as the independent claims, as well as for their own additional characterizations. Kahale and Cwilich are applied as secondary references in the above-noted obviousness rejections to certain dependent claims. Without acquiescing the characterizations of these patents and their alleged applicability to Applicants' dependent claims, Applicants note that neither Kahale or Cwilich describe generating static path, source-based routes for routing data packets in a network of interconnected nodes. Kahale describes a transmission system which models changing characteristics of a transmission medium to dynamically schedule transmission links. Cwilich

describes a method and system for computing an optimal restoration capacity and/or optimal restoration paths for a network to resolve a restoration scenario by solving a linear program model. Since neither of these patents teaches or suggests generating static path, source-based routes for routing data packets in a network of interconnected nodes *per se*, then Applicants respectfully submit that their particular approach for generating such routes as recited in the independent claims would not have been obvious to one of ordinary skill in the art based upon any combination of Huang, Newton, Kahale and Cwilich.

Claims 2, 11 & 21:

The idea of local balancing as defined in the present application under the static routing paradigm is different from the concept of load balancing between multiple local ports under the dynamic routing scheme of Huang. In Huang's case, the local balance refers to the balanced use of the multiple ports available at individual routers at any instant in time. As explained earlier and defined in paragraph [0029] of the specification, local balance in the present application means that there is a substantially uniform selection of source-destination pairs whose routes pass through a link from a complete set of source-destination pairs whose routes can pass through a link. With reference to the network figures of Huang, the whole set of source-destination pairs will be pairs of all muxes and demuxes 86 & 84.

Claims 6, 15 & 25:

The technique described at column 8, lines 1-5 of Huang does not apply to the recited invention. Applicants' invention is directed to determining a best next hop for the generated route at every switch chip so that the criterion of local and global balance is met. Applicants' invention cannot use the method used by Huang's routers to just simply alternate between the available ports. Depending upon the order in which the different source-destination pair are handled by the route generator, this simple alteration approach of Huang will not be sufficient to provide local balance. This simple selection process results in performance degradation because of overlapped routes, as shown in FIG. 7 of the present application.

Claims 7, 16 & 26:

The selection of shortest routes without prior knowledge of the type of data packets to be forwarded on the routes applies to the class of static, source-based routing networks only, which is not covered by Huang's dynamic, destination-based networks.

Claims 8, 17 & 27:

Multi-stage switch networks are common in the art. With reference to networks of the type handled by the present invention, smaller network topologies can be built without the intermediate stage boards. The approach recited in these claims is specific to larger networks with ISBs. The idea of selecting an S-D group with at least one ISB under these claims is about the technique for using them in Applicants' generation process, and not about them being used *per se*.

Claims 3-5, 12-14 & 22-24:

Scheduling based on weights is a well known concept in the art. The uniqueness of the approach presented in these claims is in the handling of the ISBs. While the simple prioritizing of the output ports based on global usage is used for NSBs, there is a double ordering involved in the handling of ISBs. The first ordering is ordering of the output ports based on the next level usage. This essentially is the number of times the next switch chip (router) has been visited in the algorithm. The ports in the output list are then sorted based on global waits on their links. If there is more than one port with the same rank order, then the tie breaker is the global weights on the respective links between the current switch chip and the neighbors' with the same rank. This idea of two-step ordering is novel to Applicants' claimed invention. In steps 2030 and 2040 of FIG. 3 in Kahale's patent, the calculation of cost is a one-step process, which is then used to determine the least-cost link in 2050. In comparison, steps 1150 and 1160 of FIG. 11 of Applicants' invention show the two-step prioritization to arrive at the desired link to use. These steps are significant to the success of the claimed process. Step 1140 is the simple prioritization sufficient for an end node or an NSB, and the complete step 1100 provides the local and global balancing desired.

For at least the above reasons, Applicants respectfully submit that all claims are in condition for allowance and such action is respectfully requested.

If a telephone conference would be of assistance in advancing prosecution of the subject application, Applicants' undersigned attorney invites the Examiner to telephone him at the number provided.

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